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The Relationship Between Offline Social Capital and Online Learning Interactions

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This article examines the interplay between offline social capital and online interactivity in higher education's online learning discussions. In a field study, we examine networks of interactions extracted from the online discussions and offline acquaintance questionnaire of four classes. Two classes belong to a traditional brick-and-mortar university, where an offline acquaintance is a common resource, and two classes belong to a distance-learning university with a loose offline acquaintance. We analyzed the offline and online networks of interactions at the individual, dyadic, and community levels. We found that there is a positive association between offline social capital and online learning interactions across all classes at the individual and dyadic levels. Using network analysis, we found evidence for a substitutional relationship between the offline and online networks at the community level, thus suggesting that online interactions may be encouraged as a complementing dimension of offline social capital.

Keywords: online learning communities, social capital, online interactivity

Online technologies have altered the way we use, design, and perceive learning. The emergence of online learning communities has advanced the potential use of social capital as a learning resource. Specifically, online discussions are increasingly becoming one of the main sociotechnical infrastructures for learning and the exchange of knowledge (see, e.g., Zhou, 2015). Here, we study the relationship between offline social capital in learning communities (as extracted before the learning duration) and online interactions (carried out during learning) in both a bricks-and-mortar and distance-learning universities. Our goal is to better understand the role of online interactivity in the social capital framework. The concept of

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social capital is relevant to learning communities through the concept of interactivity. Social interactions, in the offline and online worlds, are the foundations for the effective construction, and transfer of knowledge in communities (Daniel, McCalla, & Schwier, 2002). Thus, online interactivity may be perceived as a supplementary extension to offline social capital, or even as a causal effect to social capital (Malinen, 2015). However, it may also be a competing resource (e.g., because our social resources are limited; Dunbar, 1992), or offline social capital and online interactivity may be growing independently. Assuming there is a relation, we seek in this article to quantitatively measure this relationship using three different units of analysis: at the individual learner's level, at the dyadic level, and at the community level.

In the rest of the introduction, we discuss online social learning conceptualized through networks of interactions and operationalized via online learning discussions. Then, we briefly review the notion of social capital and its intertwining as reflected in the offline and online worlds. We connect offline and online social capital to learning settings, where offline social capital is prominent in brick-and-mortar universities and significantly less so in distance-learning universities.

Online Social Learning and Interactivity

An online learning community is a group of people who gather in cyberspace with the intention of pursuing learning goals (Kimble & Hildreth, 2008). Educational research has suggested that interactions among learners are one of the core tools underlying social learning (e.g., Barker, 1994). Specifically, online interactions are the basis of online collaborative learning, where learners are encouraged to explore conceptual knowledge and create new knowledge together online, across geographies and cultures (Harasim, 2012).

Social learning theories perceive learning as a dialogue, where participation is a mandatory condition (Hrastinski, 2009) and knowledge exists in the learners' minds, but also in the discourse and social relationships among them (Jonassen & Land, 2000). This discourse is often achieved by asynchronous online discussions that enable online-learning community members to share ideas, learn from their peers, and build knowledge collectively while reading and reflecting on each other's thoughts. The virtual settings enable less assertive participants to compose their thoughts (Hewitt, 2001) while allowing more time for all participants to reflect on and respond to others' contributions (Poole, 2000). As a result, learners can build on the comments of others, and a higher flow of communication and inference is achieved, compared with face-to-face, turn-taking discussion settings (Cook & Ralston, 2003; Garrison, 2006; Tsui & Ki, 2002).

Interactivity in learning communities was studied using many definitions (e.g., Rafaeli & Ariel, 2007; Wei, Peng, & Chou, 2015) using different operationalizations (e.g., Durairaj & Umar, 2015; Lander, 2015; Rabbany, Takaffoli, & Za, 2011; Zhu, 2006). In this study, we suggest realizing online discussions in learning communities as networks of interactions among learners and use Rafaeli's (1988) conceptualization of interactivity as a socioconstructivist process. This orientation reflects on perceiving interactivity as a process (Kelleher, 2009) of relating (constructing by hyperlinking) to others in a discussion, demonstrated many times by message transition and responsiveness (Kent & Rafaeli, 2016).

Social Capital

Social capital is one of the most ambiguous concepts in the social sciences, in addition to lacking a persistent operationalization framework (Tzanakis, 2013). The term "social capital" refers to network ties of goodwill, shared language, shared norms, and a sense of mutual obligation that people can derive value from (Huysman & Wulf, 2004).

Social capital can be viewed as an inherent parameter of the individual, or as an "investment in social relations with expected returns" (N. Lin, 1999, p. 30). There are numerous ways in which social capital can affect an individual within a social network—for example, (1) by building obligations and reciprocal trusts, (2) by obtaining potential channels of information, and (3) by creating and supporting group norms on the expense of self-interests (Coleman, 1988). Social capital is similar to human capital, but with a major difference: Unlike human capital, social capital does not exist inside one's head, but in the structure of the network among individuals, which makes it jointly owned (Burt, 1992; Coleman, 1988; Flap, 1991).

Bourdieu (1986) and Putnam (1993) on the other hand, focus on the group level and explore the ways which groups develop and maintain social capital as a collective asset, and the way social capital enhances the group members' activities. Bourdieu (1986) defined social capital as "the aggregate of the actual potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition" (p. 248). Social capital is derived from the size of past accumulated networks. Bourdieu (1986) saw the value gained from the network as the incentive of humans to engage in network construction and maintenance.

Regardless of its focus, social capital has shown to be associated with various positive social outcomes, such as better public health, lower crime rates, efficient financial markets, civic participation, and mobilization of collective actions (Adler & Kwon, 2002; Putnam, 2000).

Putnam (2000) distinguished between two types of social capital: bridging and bonding (Williams, 2006). Bonding social capital refers to the benefit from strong ties, that can be found among emotionally close agents in the network (Gittell & Vidal, 1998). Bridging social capital refers to the benefit from weak ties (Granovetter, 1973) and looser human connections, which are typically oriented around useful information rather than emotional support (Putnam, 2000). Bridging social capital widens the scale of information resources and increases the potential for external assets' access and information diffusion (Putnam, 2000). Operationalization frameworks were developed based on Putnam's perception of bridging social capital as generating broader identities and generalized reciprocity (Williams, 2006).

It is the process of relating to peers in an online conversation that emphasizes the social foundations of knowledge construction (Rafaeli & Sudweeks, 1997). Thus, in this study, we hypothesize that bridging social capital will positively associate with interactive patterns of learning online.

Offline and Online Social Capital

In 1992, Bourdieu's definition of social capital was updated to "the sum of resources, actual or virtual, that accrue to an individual or a group by possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Bourdieu & Wacquant, 1992, p. 14). By distinguishing online (virtual) and offline (actual) social capital, researchers are offered a more rigorous approach to social capital than measuring it without this distinction and by that concealing the complexity of the occurring interactions (Williams, 2006).

The Internet may reduce interpersonal interaction and communication (Nie, 2001), or transform social capital from local and group-based solidarities toward a spatially dispersed and sparsely knit interest-based social network (Quan-Haase & Wellman, 2004). However, online activity blends into people's lives and supplements in-person interactions, and reduces the loss of interpersonal interaction caused from time spent online without increasing or decreasing the overall social capital (Quan-Haase & Wellman, 2004). In any case, there is a broad agreement that both dimensions should be investigated to deeply understand social capital (Kwak & Kim, 2017).

Here, we assume that learning is a holistic experience, in which the online and offline worlds are intertwining, both in complementary and in independent manners (Deboer, Ho, Stump, & Breslow, 2014; Ferguson & Shum, 2012). Studies that have investigated the relationships between offline relations and communication in online communities have mainly been concerned about the effect that online communication has on offline ties (Trepte, Reinecke, & Juechems, 2012; Wellman & Hampton, 1999; Xie, 2007).

Very few have investigated the reverse effect of how the formation of offline relationships affects online communities (Sessions, 2010). When the online members were active in the offline community, its norms of behavior governed the online norms (Blanchard, 2004). However, the online help exchanged was shown to be beneficial to more people than the help exchanged in the offline relations, in terms of access to a wider range of experiences (Blanchard, 2004).

Offline gatherings of online communities have been shown to be an important variable in online communities' communication (H. Lin, 2007; Sessions, 2010), perhaps because of the need for richer channels of face-to-face interaction (Olson & Olson, 2000). Sessions (2010) showed that offline gathering sometimes increased bonding social capital at the expense of bridging social capital. In other words, the online members of a community who attended the offline gatherings became more strongly connected, while those who did not attend were distanced online. McCully, Lampe, Sarkar, Velasquez, and Sreevinasan (2011) have also found that offline interaction increased in the expression of social bonding, but seemed to decrease the number of online textual contributions.

Distance Learning Versus Brick-and-Mortar Universities

The traditional perception of learning communities is bound up with the notions of university campuses and physical colleges. Not long ago, it was still nontrivial to think of learning interactions that were not based on the full face-to-face range of verbal and nonverbal cues (e.g., Daft & Lengel, 1986). Today, however, online

learning in higher education is being deployed using different settings. Some university programs are instructed completely online (where there are no face-to-face interactions), whereas others use blended learning, in which online components (such as asynchronous online discussions) are part of the traditional setting of brick-and-mortar (BaM) universities.

The presence of face-to-face interactions is a result of the geographic proximity existing in BaM universities. There has been a long debate over whether physical proximity encourages learning (Bounhnik & Marcus, 2006). The literature was holding a consensus around the basic role of proximity in knowledge collaboration. The notion that effective learning is tied to proximity has been fundamentally challenged by the rise of the Internet and online learning communities (see Grabher & Ibert, 2014). Distance is even starting to be considered an “asset.” Online collaborative platforms have been shown to afford new sociotechnical opportunities for learning that are unattainable in face-to-face-only settings (see, e.g., Lander, 2015).

In this study, we investigate the relationship between offline acquaintance and online interactivity in two different higher education settings: a BaM university setting, where physical proximity is the basis for relatively extended offline social capital, and a distance-learning university setting, in which the lack of physical proximity results in much sparser offline social capital. By exploring these relations in the two settings, we wish to learn about the role of offline acquaintances in the extent of online interactivity.

Hypotheses

“Working together is easier in a community blessed with a substantial stock of social capital” (Putnam, 1993, p. 35). This statement was written in the context of civic activities. Support for a positive association between offline and online participation in voluntary organizations and politics has indeed been documented (Wellman et al., 2001). Here, we study whether this phenomenon exists in the context of online learning.

Scholars have studied the relationship between social capital and educational outcomes (Tzanakis, 2013). Social capital operationalized by parental involvement, the presence of a father in the household, children’s attendance in Catholic schools (considered a proxy for close-knit family ties), and long-lasting ties between family and school has been shown to have a positive effect on educational outcomes such as dropout rates and academic achievements (see Tzanakis, 2013). The interactive and reciprocal nature of effective online learning communities is shown to be associated with learning outcomes (Kent, Laslo, & Rafaeli, 2016). Therefore, we suggest a positive relationship between offline social capital and the learners’ level of interactivity in online social learning. For this, we are using three units of analysis.

First, we study this relationship at the individual level, then at the dyadic level (that is, investigating all interactions occurring between each pair of participants). From this point on, we use the term “student” instead of the general word “learner.”

H1: The level of online interactivity of an individual student is positively associated with his or her bridging offline social capital.

H2: The number of online interactions between pairs of students is higher if they had a prior offline relationship than if they were not acquainted offline.

McCully et al. (2011) stress that although offline gatherings among online community members may encourage motivated users, they may also undermine the overall volume of online content creation. Interactions in distance learning communities are based mostly on the online dimension. Thus, misunderstandings and misapprehensions might be harder to solve. Grabher and Ibert (2014) suggest that this ambivalence could turn out to be desirable, as it unfolds creative dynamics. As the pure online "lean" setting demands more explication, contextualization, and mutual confirmation, the distant students may be overcompensating for the absence of sensory clues with verbal explication (Grabher & Ibert, 2014). Thus, we hypothesize a substitutional relation between the volume of offline communication and online communication, at the community level.

H3: The online interactivity network and the perceived offline social capital network will substitute each other.

Method

We investigated four networks of interactions around a specific module in two different universities. Specifically, we collected two networks from a BaM university, where most people are familiar with each other, and another pair of networks from a distance-learning university, where most of the people are not familiar with each other. For each university, we extracted a pair of networks: an offline acquittance network (operationalizing offline social capital) and an online interactions network (operationalizing online learning interactivity). The offline networks were collected from the students' self-reported acquaintance questionnaire, which was administered before the beginning of the module. Because, to the best of our knowledge, the students were not engaged in online communities in the context of their learning, we assume that their prior acquaintance is based offline. Because each student reported on his or her own offline network as he or she perceived it, the self-reported acquaintance questionnaire was used to operationalize perceived offline social capital. The online interaction networks were extracted from the groups' online discussions throughout the same module. The modules for both the BaM and distance-learning universities were taught by the same instructor, who is one of the authors of this study, on the same subject (electronic markets for MBA students), and using the same online discussions platform (Ligilo, which is discussed below).

Each of the BaM and distance learning groups was composed of two different classes sharing the same online discussion scenes. Thus, we were also able to explore the intergroup offline and online interactions within each university.

The BaM university included 32 students in each class (after removing two students who did not enter the online system at all). The two classes were taught in two adjacent classrooms and regularly met in classes (within the class group) and in the department corridors (among the class groups). The distance learning university included 25 students in each class (after removing two students who did not enter the online system at all). The two classes were taught online. The students from both the universities were 25 to 59 years of age (median age = 30 years, approximately 43% female).

The online discussions occurred in an online discussion platform called Ligilo (Kent & Rafaeli, 2016), a hyperlinked discussion platform. Using Ligilo, students contribute to their community by posting (i.e., relating new posts to existing posts), reading, and by tagging these relations with semantic tags (e.g., “for example,” “makes me ask”). In addition, students can contribute by merely creating new links among existing posts (possibly contributed by two other students). We term this activity cross-referencing. Data extracted from Ligilo can be formatted as a network of students, where each interaction is designated an edge between the originating and the source student.

Units of Analysis

Social capital scholars explored the shift from the individual level to the community level to understand the collective traits of a community (Putnam, 2000). Given the criticisms concerning the lack of reliability and validity (Tzanakis, 2013) of the social capital in the community level, we wish to further explore the relationship between offline social capital and online interactivity at the collective level. We therefore analyzed the data using three units of analysis: individual students, dyads (directed pairs of Students X and Y, where X has interacted online with Y, or has indicated to know Y offline), and community (the entire network). This method allowed us to better understand the complexity of the investigated relationship. In our hypothesis, we first explore the individual (H1) and the dyadic (H2) levels. We then explore social capital at the community level (H3).

Operationalization

Coleman (1988) referred to social capital as an instrument that actors use to achieve their goals. Among such goals, reciprocity and other interactive behaviors are considered (Tzanakis, 2013). Thus, in this study, we seek to discover whether a relationship between offline social capital and interactive learning exists. Although this was not a controlled experiment, and a causal relationship cannot be established, measuring offline social capital did occur before the online learning, and thus we suggest that such instrumentation would be further examined.

Two main theoretical concepts are used as variables in this study: offline social capital and online interactivity in learning communities. Here, we extend on the operationalization of these two.

Offline Social Capital

We asked the students to fill an online questionnaire before the beginning of the term. We employed a census roster strategy (Valente, 2010). The questionnaire was composed of an acquaintance list of students in both classes in the group. Each student marked his or her friends. These lists composed a matrix of $n \times n$, where n is the number of students in both the classes in their group. Thus, the BaM matrix was 64×64 , and the distance-learning matrix was 50×50 . For each cell in the matrix (i, j), the j th student chose among four possible values (“don’t know,” “know by name,” “know from the university,” and “know beyond the university”) to describe his or her acquaintance with Student i . Thus, we were able to collect data about the offline social capital as perceived by each student.

Using Putnam's (2000) definitions of bridging and bonding social capital, and their corresponding interpretation as weak, loose, and information-oriented connections versus strong, emotionally close ties (Putnam, 2000), we operationalized bridging social capital as acquaintances of levels ("know by name") and ("know from university") and acquaintances of level ("know beyond university") as associated with bonding social capital. Hypothesis 1 was focused specifically on bridging social capital, while for Hypotheses 2 and 3, we did not find a methodological reason to separate bonding and bridging.

Online Interactivity

Previous studies concerning the relationship between the activities of online communities and social capital have measured community participation by metrics such as the number of contributed posts in online discussions and the average length of the posts (Li, Yang, & Huang, 2014; McCully et al., 2011; Sessions, 2010; Shen & Cage, 2015). In this study, we investigate the relationship between offline social capital and online interactions in the context of social learning. Social learning emerges out of the interactions in the online discussions, and thus we extended the operationalization of the online activity from a framework of "participation" to a framework of "interaction." Sol, Beers, and Wals (2013) defined social learning as "an interactive and dynamic process in a multi-actor setting where knowledge is exchanged and where actors learn by interaction and co-create new knowledge in ongoing interaction" (p. 3). Consequently, when operationalizing interactivity, we add the dimension of relating to each other's postings by taking conversational turns (Rafaeli & Sudweeks, 1997).

Behaviors such as viewing and clicking on external content emphasize listening, which is central to learning (Scardamalia & Bereiter, 1994; Wise, Speer, Marbouti, & Hsiao, 2012). Ignoring these so-called passive participation is a misconception of social learning. Hence, we measured the content's consumption in addition to content's creation. The following is the set of interactivity parameters:

1. Number of posts contributed by a student
2. Number of posts contributed by a student as a response to other students' (i.e., which we term as reactive posts, as opposed to posts that were contributed by students as a response to their own previous posts)
3. Number of views on posts made by a student
4. Number of students' views on other students' posts (i.e., which we term as reactive views, as opposed students' views on their own posts)
5. Average number of views operated by other students in the community on the student's posts
6. Average number of posts that are related from the student's posts (i.e., out degree)
7. Average number of posts that are related to the student's posts (i.e., in degree)
8. Number of relations the student has created between two other already existing posts (i.e., cross-references)
9. Average number of words in the student's posts (i.e., the average length of posts)
10. Number of clicks on URL links embedded in posts
11. Number of clicks to open files attached to posts

Social Network Analysis

Because the study includes a small number of networks, the network-level analysis is descriptive. We mapped four main networks (i.e., BaM offline acquaintance, BaM online interactions, distance-learning offline acquaintance, and distance-learning online interactions). The students are the nodes in all four networks. In the offline networks, a directed edge was formed between Student X and Student Y if X reported that he or she knows Y. In the online networks, a directed edge was formed between Student X and Student Y if X had at least one online interaction with Y (e.g., X responded to a post written by Y, X has read a post written by Y). Both network types had their meanings for the edge weight. Namely, the weight of the edge in the offline network depicts the acquaintance strength, and the weight of the edge in the online network signals the number of directed interactions. Because the lack of a theoretical relevant reason, we have considered all interaction types as having the same weight.

Because both the BaM group and the distance-learning group included two separate classes, we investigated the interclass activity (i.e., interactions made among students from two different classes) and the proportion of these interclass activities out of the entire network. The ratio between the interclass communication and the whole group communication is a proxy to the community's ability to bridge among classes. We applied social network analysis to the four networks and calculated four network parameters.

Network density is the ratio between the connections in the network and the maximum potential connections in the network. The density is a proxy for the volume of interactions among all students in the network. A higher density means more interactions among different students.

Network diameter is the shortest distance between the two most distant students in the network. The diameter reveals the nature of the interaction. Did everybody respond to everybody else (low value of the diameter), or were there groups that did not communicate with other groups (a high value of the diameter)?

Network clustering coefficient is a measure of the degree to which students in the network tend to cluster together. The clustering coefficient is another parameter that can tell us whether the interactions in the network are from every student to every other student (high clustering coefficient) or are between specific students (low clustering coefficient).

Network modularity is a measure of the strength of separation of a network into groups of students. High network modularity means that each group of students has dense connections between students in the group and sparse connections with the students in other groups. Low network modularity is a signal of a network where groups hardly exist.

Results

Offline Acquaintance

First, we compare the number of self-reported offline ties, as extracted from the acquaintance questionnaire. Figure 1 shows the proportion of offline ties out of the potential number of ties, in each university, as reported by the students.

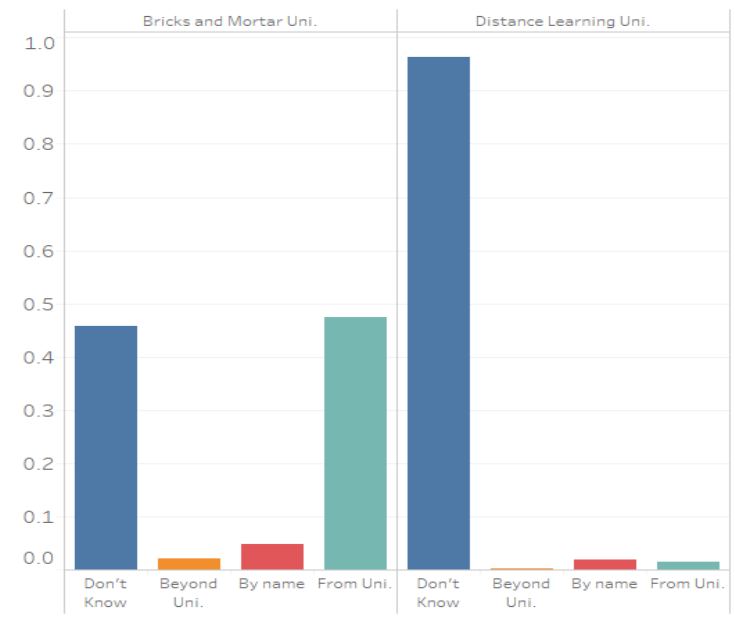


Figure 1. The proportion of offline ties out of the potential number of ties in the offline network. Tabular views of the same data are available in Table A1 in the Appendix.

As seen in Figure 1, the BaM university's offline network consists of more weak ties (where students are acquainted only by name or are familiar in the context of their studies) and more strong ties (where students are acquainted beyond the context of studying together), in comparison to the distance-learning university. As the data were not normally distributed, we used a Mann-Whitney U test, that showed that this advantage was statistically significant both in the number of weak ties the students reported having ($U = 19.50$, $p < .001$, mean of the distance-learning university = 1.68, $SD = 2.14$, where the mean of the BaM = 32.89, $SD = 9.23$), as well as in the number of strong ties the students reported having ($U = 725.50$, $p < .001$, mean of the distance-learning university = 0.14, $SD = 0.35$, where the mean of the BaM = 1.28, $SD = 1.42$). This result was not surprising, as the BaM students enjoyed the physical proximity that the distance students did not have. However, it statistically anchored the difference in the offline social capital between the two study settings.

The Individual Level

We have hypothesized that the levels of interactivity measures are positively correlated with the offline perceived social capital (H1). Here, we correlate these measures at the level of an individual student. As our data were not normally distributed, we used a Spearman's rank-order correlation, that has surprisingly shown significant negative correlations between the number of perceived weak offline ties and the number of contributed reactive posts ($r = -.187, p < .05$), number of reactive views ($r = -.285, p < .01$), average number of views by others on the student's posts ($r = -.363, p < .01$), average in degree ($r = -.597, p < .01$), and average length of post ($r = -.256, p < .01$). The number of contributed posts was the only variable that correlated positively with the number of weak offline ties ($r = .238, p < .05$). All the other relationships were nonsignificant. Descriptive statistics of the online interactivity measures are shown in Table A2 in the Appendix.

To better understand the negative slope, we plotted these relationships and found that the negative relationships were concealing positive correlations, which appeared when we separated our analysis by the two different universities. This statistical bias is called the Simpson paradox (Lerman, 2017), and it is shown in the Figure 2.

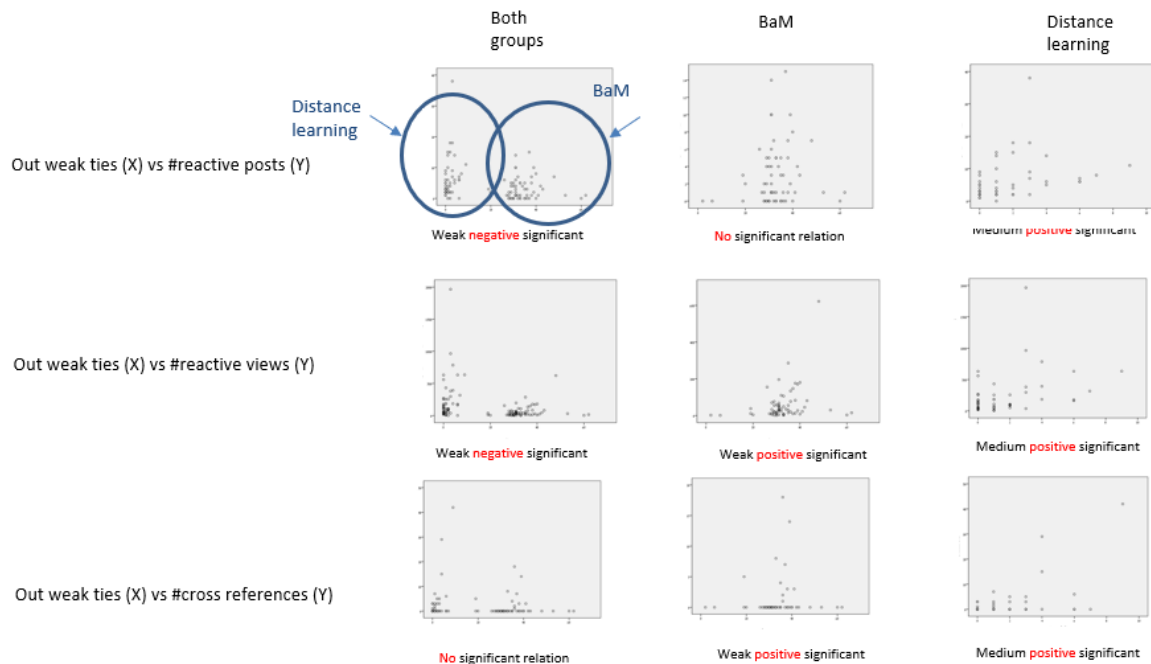


Figure 2. Simpson paradox examples. Negative correlations when accounting for both groups became positive when applied to each group separately.

A Spearman's rank-order correlation applied separately to each university's students showed mainly positive correlations between the number of perceived weak offline ties and interactivity measures.

The distance learning university showed significant medium positive correlations between interactivity measures and the number of offline weak ties. There were correlations in the distance learning university with the number of contributed posts ($r = .500, p < .01$), number of contributed reactive posts ($r = .498, p < .01$), number of views ($r = .397, p < .01$), number of reactive view ($r = .416, p < .01$), number of clicked links ($r = .364, p < .01$), number of clicked files ($r = .367, p < .01$), and number of cross-references ($r = .340, p < .05$). The average number of views by others on the student's posts was the only variable showing a negative correlation ($r = -0.328, p < .05$). All the other relationships were nonsignificant.

The BaM university showed weaker significant positive relationships between interactivity measures and the number of weak offline ties, which may suggest that this effect was stronger in the distance-learning settings. There were correlations in the BaM university between the number of offline weak ties and the number of contributed posts ($r = .329, p < .01$), number of views ($r = .310, p < .05$), number of reactive view ($r = .280, p < .05$), and number of cross-references ($r = .264, p < .05$). All the other relationships were nonsignificant.

The Dyadic Level

We explored the dyadic level to see whether pairs of students who had a prior offline tie showed significantly more online interactions (i.e., higher weight of each connection) than those pairs who had no prior offline acquaintance (H2). Of all the possible pairs, 42.04% were interacting online in the distance-learning university and only 28.22% in the BaM. Our data were not normally distributed. Thus a Mann-Whitney U test was carried to test the difference between the group of previously acquainted pairs and those who were not. The results showed a significantly higher number of online interactions in the distance learning university ($U = 92,407.00, p < .001$) and in the BaM university ($U = 1,953,905.00, p < .001$). This finding supports our assumption that offline acquaintance correlates with online interactions.

The Community Level

Offline Versus Online Networks

First, we compare the network parameters of the online networks to those of the offline networks, without distinguishing between the study settings (i.e., BaM vs. distance learning). Because the edge weights of the offline networks are scaled differently from the weights on the online networks, we compare structural parameters without calculating the strength of the offline acquaintance or the volume of online interactions. As seen in Figure 3, the value of both the offline networks' diameter is higher than in both the online networks' diameter value, suggesting that the online interactions in our two case studies have been bringing people closer than the offline interactions have.

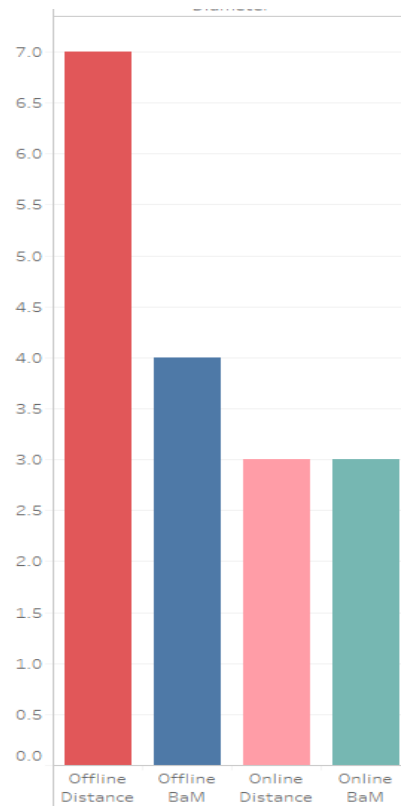


Figure 3. The diameters of the whole networks.

As shown in Figure 4, the online networks have a larger proportion of the interclass density (density of the subnetwork of interactions made among students from two different classes) out of the whole network's density and smaller proportion of the interclass modularity out of the whole network modularity, in comparison to the offline networks. These findings suggest that the online networks are more successful in breaking the interclass boundaries.

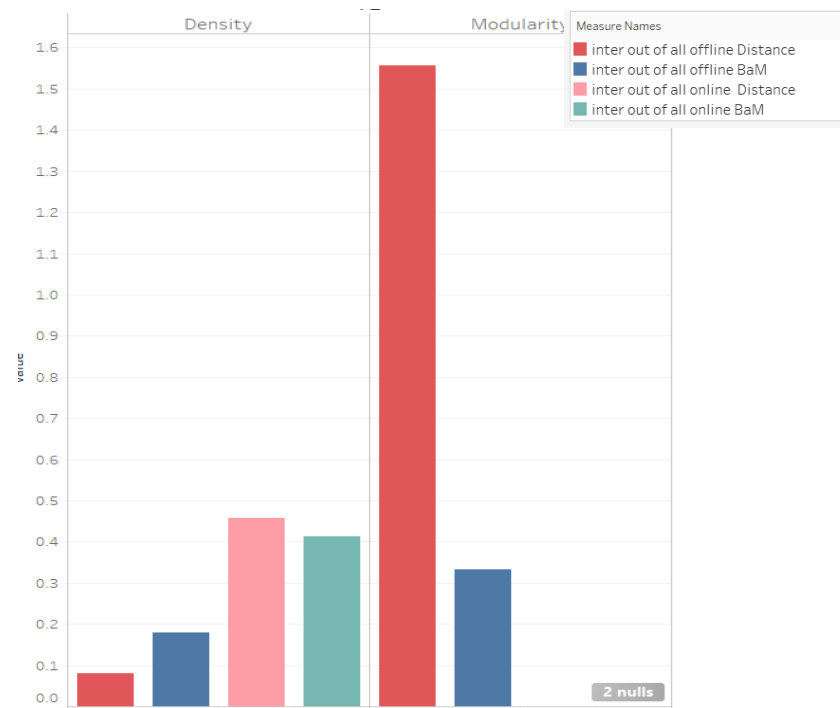


Figure 4. Left: The proportion of the interclass interaction's density out of the whole group's density. Right: The proportion of the interclass interaction's modularity out of the whole group's modularity. Tabular views of the same data are available in Table A3 in the Appendix.

Figure 5 presents the high volume of interclass interactions in the online networks compared with the offline networks and the success of the online networks in enabling students from different classes to interact. The online networks of both the distance-learning and the BaM universities are more interactive than their associated offline networks.

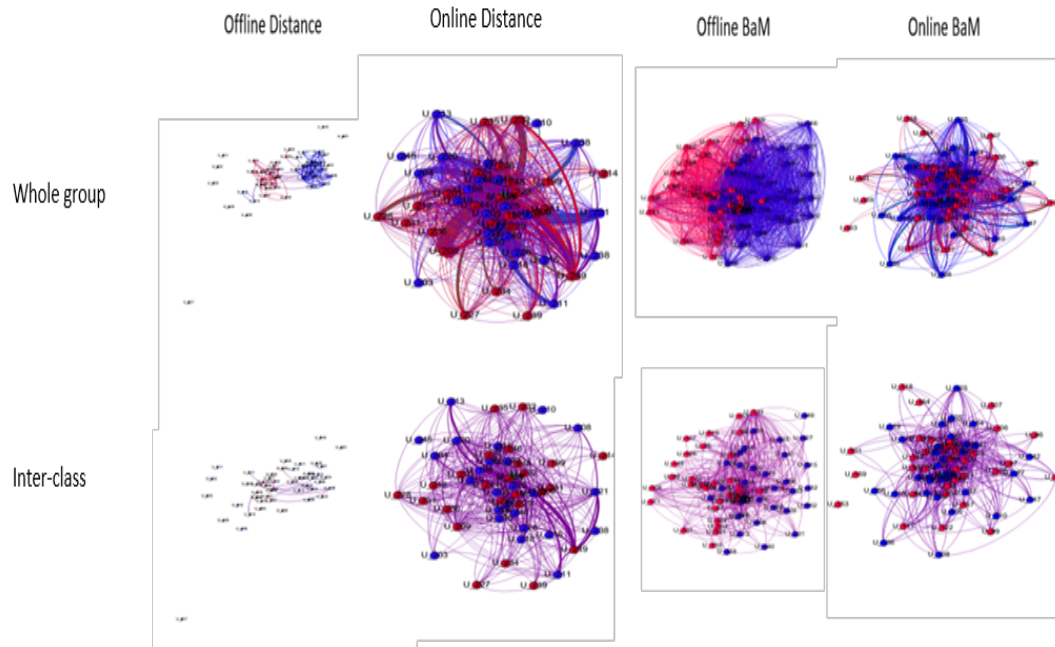


Figure 5. Interclass versus whole networks.

BaM Learning Versus Distance Learning

Next, we explore whether offline interactions substitute online interactions (H3). Although the groups were not significantly different in the number of contributed posts, the distance-learning students exhibited more interactive behavior. A Mann–Whitney U test found this advantage in the number of reactive posts ($U = 896.50, p < .001$), the number of reactive views ($U = 654.00, p < .001$), the average number of attached files ($U = 896.50, p < .001$), the average number of views by others on the students' own post ($U = 818.50, p < .001$), the average out degree ($U = 1,109.00, p < .05$), the average in degree ($U = 204.50, p < .001$), and the average length of posts ($U = 987.00, p < .001$).

The offline network of the BaM is significantly more acquainted than that of the distance-learning group (offline acquaintance section). The offline network of the BaM also shows greater density in both the whole interactions graph (0.53 vs. 0.05 in the distance learning), as well as in the interclass interaction graphs (0.1 vs. 0 in the distance learning) and has a larger relative part of the interclass density (0.18 vs. 0.08 in the distance learning), larger clustering coefficient (0.71 vs. 0.2 in the distance learning), and smaller modularity (0.3 vs. 0.41 in the distance learning).

Additionally, as seen in Figure 6, the offline density is lower than the online density in the distance-learning group and vice versa in the BaM. The clustering of the offline network is lower than the clustering of the online network in the distance-learning group and vice versa in the BaM. These results may suggest that to some extent, offline and online interactions complement or even substitute for each other.

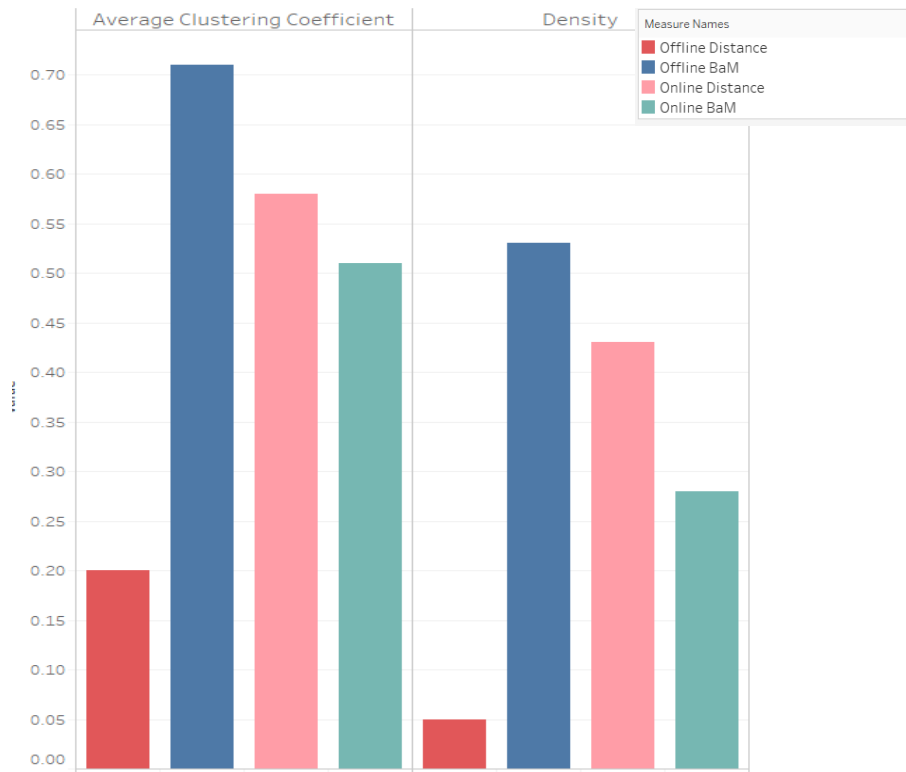


Figure 6. Average clustering coefficients and densities.
Tabular view of this data is available in Table A3 in the Appendix.

The online interactions in the distance-learning group have greater density than those in the BaM, in the whole interaction graph (0.43 vs. 0.28 in the BaM), in the interclass graph (0.20 vs. 0.12 in the BaM), and in the relative part of the intergroup density (0.46 vs. 0.41 in the BaM). The online network of the distance learning group has a larger clustering coefficient (0.58 vs. 0.51 in the BaM) and has smaller modularity in the intergroup graph (0.04 vs. 0.10 in the BaM). These findings are presented in Figure 7 and support the existence of a substitutional mechanism between offline and online interactions.

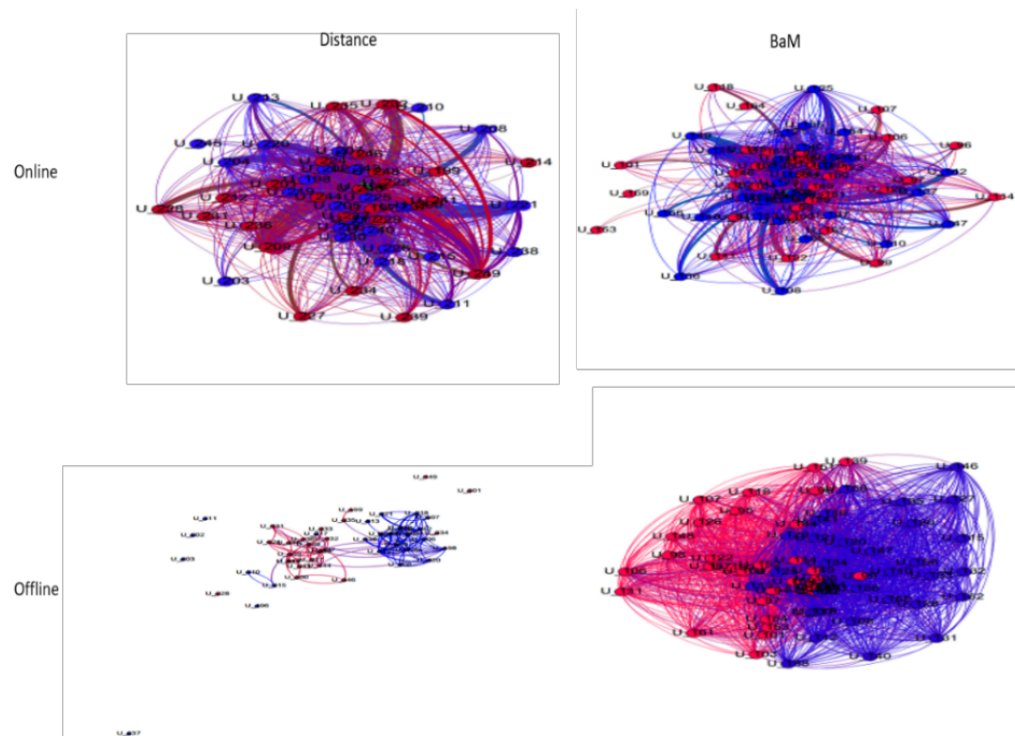


Figure 7. BaM versus distance learning in online versus offline networks

The network-level comparison and the students' patterns of behavior indicate a complementary mechanism between offline acquaintance and online interactions. The online behavior is more interactive when offline interactions are sparser.

Conclusions

The invasion of online identities and communities into our lives has undoubtedly changed (and will probably change further in the future) the blend and composition of social capital, both as a resource of its own as well as the mean for other targets (such as learning). The emergence of a whole new scale of learning environments, alternative to those based on proximal geographies and face-to-face interaction, is a well-designed sandbox in which the specific blending of online and offline social capital can be investigated.

Social capital is a resource embedded in human interactions. The notion that learning is facilitated by, and based on, interactions among students (Barker, 1994; Haythornthwaite & De Laat, 2010; Sol et al., 2013) connects social capital and learning. Social capital has been suggested to affect learning as it becomes self-generating through learning interactions (Baker, 2006). Thus, the confusion around the conceptualization of social capital as the instrument or the outcome (Tzanakis, 2013) makes the causal direction questionable.

Therefore, in this study, we explore the relationship between offline social capital and online learning interactions, as expressed through online discussions, in a broader correlational nature. Previous scholars have investigated aspects of this relationship such as the effect of offline meetups on online discussions (e.g., McCully et al., 2011; Sessions, 2010). The concept of social capital is considered highly context specific in terms of social, cultural, and economic fields (Tzanakis, 2013), and we explore the correlation between offline social capital accessible to students and the volume of online learning interactions in higher education, as shown in distance-learning and brick-and-mortar universities.

Our investigation of the first and second hypotheses has shown that the relationship between online interaction in learning communities and offline social capital is positive, both at the level of the individual student (where we focused on bridging social capital) and at the dyadic level, which means this is more than merely a human trait. This evidence indicates the importance of these two channels to each other. For example, two students who maintain a weak tie in the offline world would be more likely to interact online than two students who did not maintain such a tie. This result has practical implications, by showing the importance of interactions, especially in the world of distance learning and massive open online courses, where most people are not acquainted offline before gathering in online communities.

Theoretically, there is a long and complex scholarly discussion on the interrelationship between the offline and online worlds. Some perceive online interactions as supplementing or replacing offline interactions (Wellman et al., 2001), and some perceive the online world as augmenting and supporting preexisting offline relationships (Ellison, Steinfield, & Lampe, 2007; Vergeer & Pelzer, 2009). The concept of a "multiplex" relationship (Kapferer, 1969) perceives a relationship characterized by multiple bases of interaction, where a tie is more strongly maintained if it is based on multiple bases of interaction. Thus, the existence of both offline and online interactions is said to strengthen a tie.

Ellison et al. (2007) have demonstrated a positive connection between Facebook usage and indicators of social capital, especially of the bridging type. Investigating Hypothesis 1 shows that bridging offline social capital, as operationalized by the number of weak relations, is associated with more interactive patterns in learning communities. This result may suggest that learning interactions represent a form of bridging social capital applied in the context of learning.

Hypothesis 3 was set to find any evidence of a substitutional relationship between online and offline interactions at the community level. The results showed that the BaM classes were significantly more offline acquainted than the distance-learning group, whereas the distance-learning group was significantly more interactive online. The offline network of the BaM was denser, had larger average clustering coefficient, and had smaller modularity relative to the offline network of the distance-learning groups. The students in the offline network of the BaM declared they had many links to each other, without any significant grouping inside the class. Generally, they acted as one network, compared with the offline network of the distance learning, which could be described as a gathering of distinct groups.

However, exploring the online networks of both distance-learning groups and BaM groups, we discovered that the distance-learning network had larger density, larger average clustering coefficient, and smaller modularity relative to the BaM university group. The students in the online network of the distance

learning acted as an integrated network, whereas the online behavior of the BaM university students was group oriented.

These results suggest that students without previous acquaintance and with a small volume of offline social capital still managed to create an online network that had a lot of links, through which knowledge could easily be transferred. Therefore, it seems that in a very specific way, substitutional relations occur between offline interactions and online interactions at the community level.

One of the possible explanations for this substitutional mechanism is the spiral of silence theory (Noelle-Neumann, 1973), developed in the context of traditional media. It proposes that people remain silent when they expect their opinions to fall in the minority. Previous studies examined the spiral of silence in online discussions and suggested that the online setting can cause the discussants' opinions to be perceived as more moderate than in offline settings (McDevitt, Kiouisis, & Wahl-Jorgensen, 2003), perhaps due to the participants' awareness of their offline acquaintance. In other words, offline acquaintances and their social capital play a negative role in the BaM online class concerning the students' willingness to speak out. However, the reason for the underlying mechanism should be further investigated. On the other hand, one implication can be very specific to distance-learning endeavors, to invest in online interactivity, under the view of the importance of bridging social capital, that can be complemented when no offline acquaintance took place.

Limitations

This field study was not experimentally controlled. It was focused on a specific module's and instructor's learning design and academic subject, using a single Web platform. These factors may all be barriers to the ability to generalize from our results, in addition to being drawn from a limited sampling frame (Hargittai, 2015). When investigating Hypothesis 3, we compared four classes from two universities. The difference between these two universities might not be attributed only to being distance-learning versus a brick-and-mortar institution. For example, the effect might be due not only to a prior acquaintance but also to ongoing offline meetings in the hallways throughout the term. Additionally, we focused on quantitative analysis methods, while surely triangulation with qualitative methods could have revealed further insights (McCully et al., 2011).

One of the most serious limitations of social capital studies is their high sensitivity to context. For example, some experiments have been conducted to connect learning and education to social capital. However, their effects have been shown to diminish after controlling for socioeconomic status and other personal traits (Tzanakis, 2013).

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Appendix

Table A1. The Percentage of the Reported Offline Ties out of the Potential Number of Ties in the Offline Network.

	Don't know	Beyond uni.	By name	From uni.
Brick and mortar uni.	45.71%	2.03%	4.71%	47.50%
Distance learning uni.	96.29%	0.29%	1.96%	1.47%

Note. uni. = university.

Table A2. Descriptive Statistics of the Online Interactivity Measures.

	Distance mean	Distance SD	BaM mean	BaM SD
Number of posts	8.02	1.19	7.52	0.70
Number reactive posts	6.24	0.91	2.98	0.44
Number of views	282.22	55.23	185.84	22.99
Number reactive views	240.60	46.70	60.68	11.64
Average number of views by others	16.59	1.95	7.73	0.74
Average out degree	1.15	0.15	0.69	0.09
Average in degree	1.48	0.09	0.62	0.06
Cross-references	2.56	1.05	1.03	0.40
Average length of posts	141.72	14.72	79.52	7.56
Number of clicks on URLs	1.78	0.58	1.33	0.43
Number of clicks on files	18.14	3.15	6.33	0.87

Note. SD = standard deviation; BaM = brick and mortar.

Table A3. Proportion of the Interclass Interaction's Density out of the Whole Group's Density, the Proportion of the Interclass Interaction's Modularity out of the Whole Group's Modularity, Densities and Average Clustering Coefficients of All Four Networks.

	Offline distance	Offline BaM	Online Distance	Online BaM
Interclass proportion of density	0.08	0.18	0.46	0.41
Interclass proportion of modularity	1.56	0.33	–	–
Density	0.05	0.53	0.43	0.28
Average clustering coefficient	0.20	0.71	0.58	0.51